Appendix A

INTEC Perched Water Reduction Workshop Record

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INTEC PW RECHARGE REDUCTION

WORKSHOP RECORD

March 16, 2006
0800-1530 hours

TSA Conference Room A
Idaho Falls, Idaho

Facilitated by:
William "Buck" West
208-526-1314
william.west@inl.gov

Workshop Objectives

Evaluate possible options to reduce infiltration and perched water recharge beneath northern INTEC.

Attendees

NAME	PHONE #s	E-MAIL
Cahn, Lorie S	526-3080 307-690-5307	Lorie.Cahn@icp.doe.gov
Doornbos, Martin H	526-0676 521-7839	Martin.Doornbos@icp.doe.gov
Forbes, Jeffrey R	526-9685 520-0272	Jeffrey.Forbes@icp.doe.gov
Forsythe, Howard S	526-1603 520-1307	Howard.Forsythe@icp.doe.gov
Hurst, C Jestin	526-3115 521-5575	C.Hurst@icp.doe.gov
Janikowski Stuart K	526-0265	Stuart.Janikowski@icp.doe.gov
Schwendiman G Lynn	526-8732	Lynn.Schwendiman@icp.doe.gov
Shanklin Dean E	526-4644 520-4918	Dean.Shanklin@icp.doe.gov
Shepherd, Todd A	526-0595 520-9673	Todd.Shepherd@icp.doe.gov
Varvel, Mark D	526-4424 520-6023	Mark.Varvel@icp.doe.gov

Decisions or Conclusions

The top ten options based on the weighted total scores are:

1. Capture roof runoff at downspouts in SRCZ and route water to existing lined ditches and evaporation pond. (Weighted Total = 25.93)
2. Perform pipeline valve isolation tests to identify leaky segments in suspect areas based on water levels and/or Perform pipeline hydrostatic testing to identify leaky segments. (Weighted Total = 23.80)
3. Expand paved areas secondary recharge area and Extend concrete-lined ditches to areas further away from tank farm (within secondary zone). (Weighted Total = 23.36)
4. Eliminate lawn watering. (Weighted Total = 22.47)
5. Revegetate with dry land species outside the SRCZ. (Weighted Total = 22.36)
6. Eliminate steam condensate drip leg discharges to ground. (Weighted Total = 22.04)
7. Extend concrete-lined ditches to areas further away from tank farm (within secondary zone). (Weighted Total = 21.80)
8. Conduct regular water balance calculations to highlight changes in system flows that could indicate leaks. (Weighted Total = 21.49)

9. Establish snow accumulation areas that drain to existing lined ditches and evaporation pond. (Weighted Total = 21.22)
10. Install asphalt or concrete in unlined north ditch to eliminate infiltration. (Weighted Total = 21.07)

Process

The meeting used computer-assisted facilitation using GroupSystems® *Meeting Room* software. Each participant had access to a computer, linked with other computers in the room. Information entered by the recorder or other participants appeared simultaneously on everyone's computer. Any ranking or scoring of issues or needs was done via the computers and the results were immediately available for review and discussion. Comments and scoring information were recorded anonymously. Any information entered into the computers, including ranking or scoring information, became part of the meeting record.

The meeting opened with some brief remarks by Howard Forsythe and Marty Doornbos regarding the purpose of the meeting and how the results of this scoring process will be used. Jeffrey Forbes then made a presentation on the background and information leading up to this meeting (see Appendix A).

The group reviewed the evaluation criteria for clarity and completeness. The original criteria were:

- Lifecycle cost of the option (7=$100,000, 5=$500,000, 1=$1,000,000)
- Proximity of the option to the source areas (7=Within Tank Farm Boundary, 5=Within Secondary Recharge Zone, 3=Inside INTEC Fence Line 1=Outside of northern INTEC)
- Reduction of recharge volume (7=1,000,000 gal/yr, 5=500,000 gal/yr, 1=1,000 gal/yr)
- Time to implement (1=next year, 5=3 years, 1=5 years or more)
- Lifespan of the option (7=10 years, 5=5 years, 1=1 year)

The group believed that the lifespan criteria was included in the lifecycle cost and would give excessive weight to the time element of a project. The lifecycle criteria was modified to assess the confidence the group had in the ability of the option to impact the perched water. Other criteria and scales were also modified for clarity. The final evaluation criteria were:

- Lifecycle cost of the option (7=<$100,000, 4=$500,000, 1=>$1,000,000)
- Proximity of the option to the source areas (7=Primary Recharge Zone, 5=Within Secondary Recharge Zone, 3=Inside northern INTEC, 1=Outside of northern INTEC)
- Reduction of recharge volume (7=>1,000,000 gal/yr, 4=500,000 gal/yr, 1=<100,000 gal/yr)
- Time to implement (7=<3 yr, 4=5 yr, 1=>7 yr)
- Confidence in recharge reduction of shallow perched (7=100%, 4=60%, 1<10%)

The group then weighted the criteria by allocating five points between the criteria in increments of no smaller that 0.1. The results of the weighting are found in the following Table 1. This table shows how the participants allocated their 5 points. The number in each cell of the matrix indicates the number of participants who allocated that number of points to the criteria.

Criteria	Allocation Range										Total	Weight	STD
	0.0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.1-2.5	2.6-3.0	3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0			
Reduction of recharge volume	1	3	3	2	1						14.5	1.45	0.60
Proximity of the option to the source areas	1	3	5	1							12.5	1.25	0.54
Confidence in recharge reduction of shallow perched	3	4	3								10.0	1.00	0.41
Lifecycle cost of the option	6	1	3								7.2	0.72	0.55
Time to implement	7	2	1								5.8	0.58	0.47

Table 1. Weighting Scores for Criteria

The group then reviewed the options, within the four categories of:

1. Precipitation
2. Anthropogenic Water
3. Possible ways to evaluate success of remedial actions
4. Methods to identify and locate pipeline leaks

Minor modifications were made to the options in the first two categories. The group agreed that the options in category 3 were beyond the scope of this workshop and were not considered for evaluation. The options in category 4 were merged with the options in category 2 and reviewed to make sure there were no duplicates.

During the discussion of the options it was stressed that these were early conceptual designs and did not have detailed information for each option. The participants would be scoring each option on how well they believe the option meet the criteria. The intent was to use this scoring to reduce the number of options to a manageable level that could then be researched in more detail.

The group scored the options against the criteria without any category designations. All the options, regardless of the category, would eventually be considered against each other and there was no need to carry the categories into the scoring activity. The results of this scoring activity can be found in Figure 1 with detailed scoring results in Appendix B of this record.

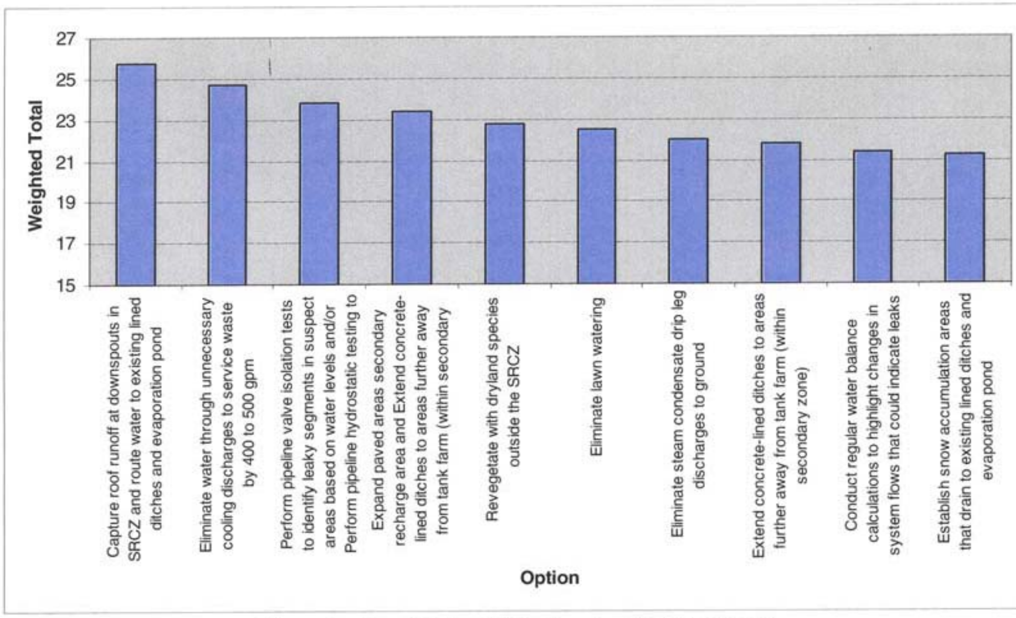


Figure 1. Round 1 Top 10 Options by Weighted Total

After reviewing the results the group discussed some of the options and concluded that there had been different interpretations of some of the options. The group then modified their original scores based on the discussion. The results of this second round of scoring can be found in Figure 2 with detailed scores in Appendix C of this record.

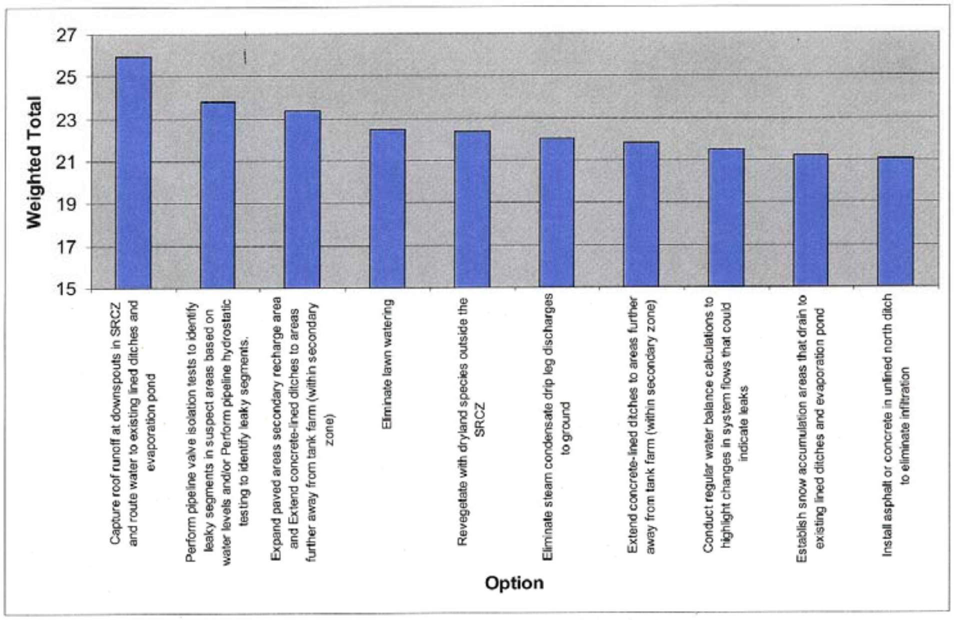


Figure 2. Round 2 Top 10 Options by Weighted Total

The meeting adjourned after briefly reviewing the results from the second round of scoring.

Analysis of Results

The criteria were examined for how well they contributed to the selection of the preferred alternative. This examination focused on:

1. Was there discrimination between the alternatives for that criterion?
2. Was the rating group in consensus on their alternatives scores?
3. How much uncertainty is there in the scoring of the alternatives against the criteria?

All the criteria showed some discrimination between the options. The least discriminating criteria were "Time to implement" and "Confidence in recharge reduction of shallow perched." The scores for "Time to implement" ranged from 4.25 to 7.00, while the scores for "Confidence in recharge reduction of shallow perched" ranged from 1.38 to 5.71. Because there was some separation between the alternatives for these criteria no strong argument could be made for eliminating any criteria.

Of the top ten alternatives considered, the group exhibited the highest degree of consensus for eliminate lawn watering, followed by, eliminate steam condensate drip leg, asphalt unlined north ditch and revegetate with dry land species. Consensus scores were calculated using the Ventana Coefficient of Consensus (VCC). VCC is a measure of the agreement or disagreement on the group's rating. The smaller the spread in scores compared to the possible range in scores, the better the level of consensus. A value of 1.00 represents complete consensus (no variation between scores) while a value of 0.00 represents no consensus (maximum variation between scores). The VCC values show moderate to high consensus on the scoring of each options/criterion combination (see page 30 for individual combinations). Figure 3 shows the frequency of consensus scores for the 26-option/criterion combinations. Table 2 shows the range of consensus scores for the top ten options.

Option	High	Low	Mean
Capture roof runoff at downspouts in SRCZ and route water to existing lined ditches and evaporation pond	0.64	0.43	0.56
Perform pipeline valve isolation tests to identify leaky segments in suspect areas based on water levels and/or Perform pipeline hydrostatic testing to identify leaky segments.	0.76	0.23	0.41
Expand paved areas secondary recharge area and Extend concrete-lined ditches to areas further away from tank farm (within secondary zone)	0.88	0.27	0.51
Eliminate lawn watering	1.00	0.33	0.72
Revegetate with dry land species outside the SRCZ	0.76	0.47	0.59
Eliminate steam condensate drip leg discharges to ground	0.88	0.13	0.64
Extend concrete-lined ditches to areas further away from tank farm (within secondary zone)	0.57	0.37	0.47
Conduct regular water balance calculations to highlight changes in system flows that could indicate leaks	1.00	0.19	0.49
Establish snow accumulation areas that drain to existing lined ditches and evaporation pond	0.85	0.26	0.52
Install asphalt or concrete in unlined north ditch to eliminate infiltration	1.00	0.41	0.61

Table 2. Ventana Coefficient of Consensus (VCC) for Top Ten Options

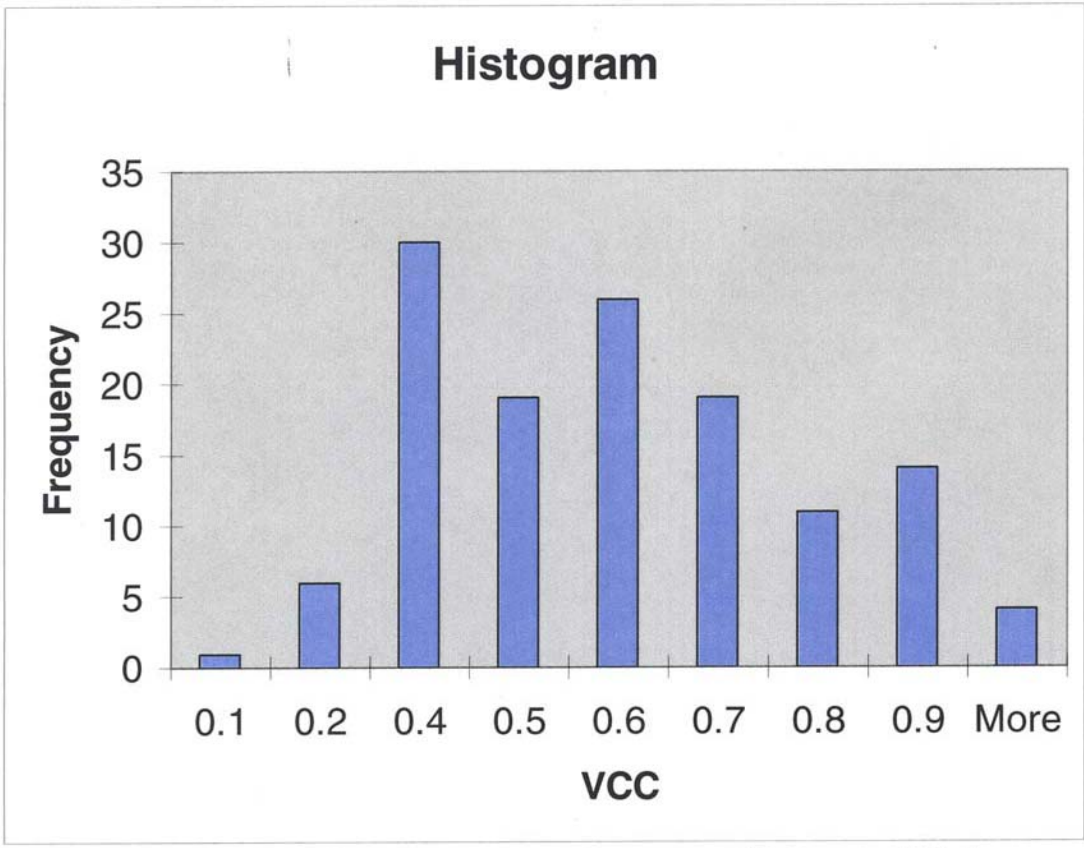


Figure 3. Distribution for Ventana Coefficient of Consensus (VCC) Scores for All Options

The means and standard deviations for each option/criterion combination were entered into the *Criterium Decision Plus*© software. The possible decision scores for each option were calculated along with the probability that the option could have a specific score. Figure 4 shows the probability distributions for the top five alternative scores.

Instillation of downspouts had both the highest mean score and the highest weighted score of the top five options but the second highest probability distribution. Eliminating lawn watering had the second highest mean score, the fourth highest weighted score, and the highest probability distribution of the top five options. The remaining options had generally the same mean score and probability distributions. Generally the participants were more confident about their scores for the elimination of lawn watering than they were about their scores for installing downspouts.

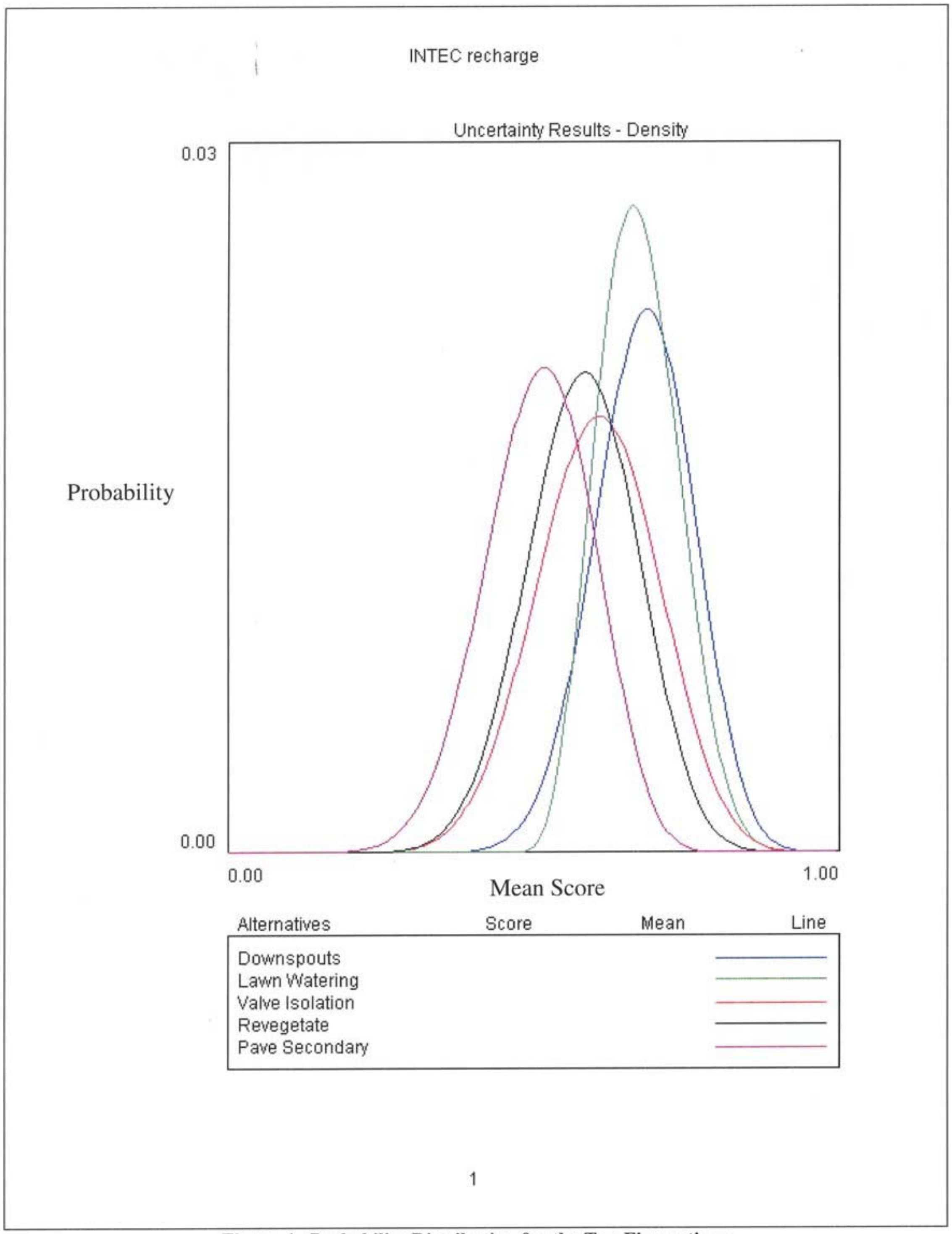
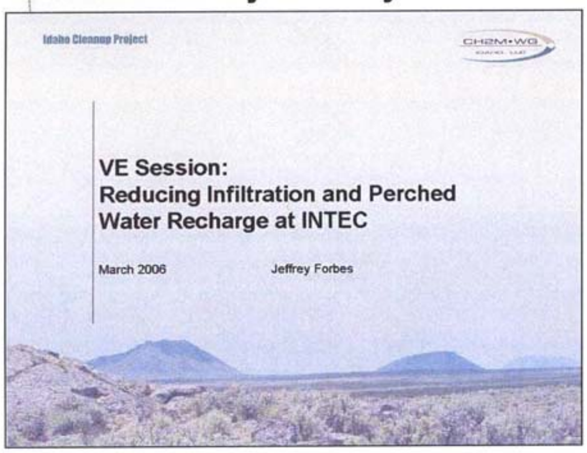


Figure 4. Probability Distribution for the Top Five options

Appendix A: Presentation by Jeffrey Forbes



Shallow Perched Water at INTEC

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- Depth: 100 to 140 feet below ground surface
- Perched water volume: 5 to 20 million gal (varies seasonally)
- Perched water recharge sources:
  - Precipitation infiltration
  - Big Lost River infiltration (when flowing)
  - Clean water discharges & leaks
- Contains high concentrations of Sr-90 (>100,000 pCi/L)
- Shallow perched water has persisted during drought 2000-2005
- Contaminated shallow perched water continues to move downward, but Sr-90 impacts from the shallow perched water have not yet been observed in the aquifer

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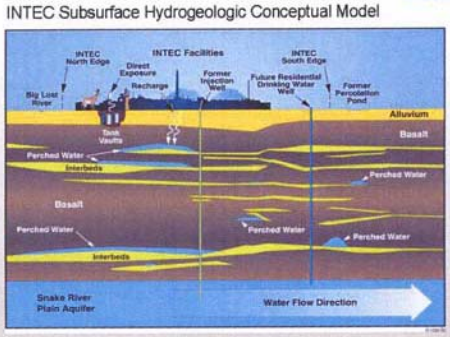
INTEC Subsurface Hydrogeologic Conceptual Model



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Lateral Extent of Northern Shallow Perched Water in 2005
Idaho Cleanup Project
Dry
Wet
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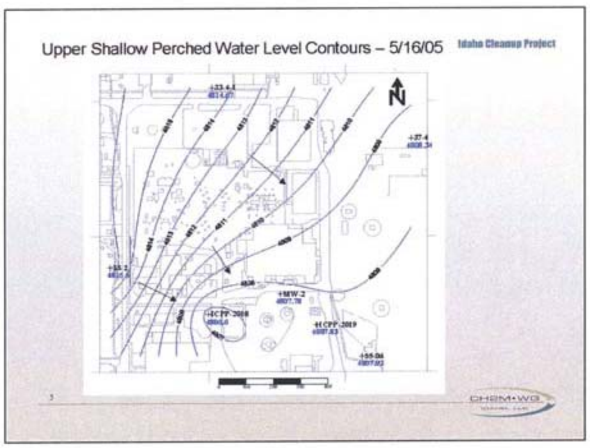
Upper Shallow Perched Water Level Contours – 5/16/05
Idaho Cleanup Project
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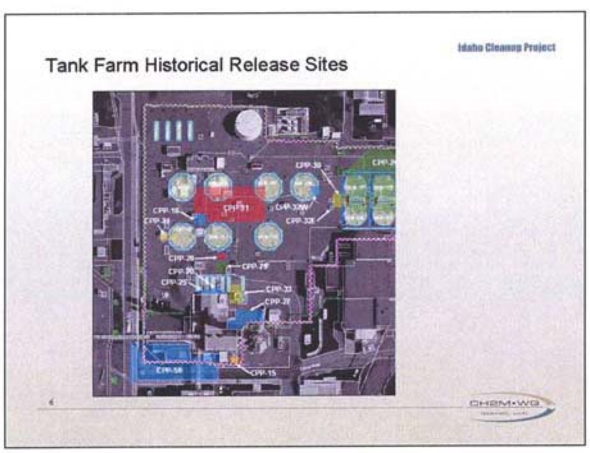
Tank Farm Historical Release Sites
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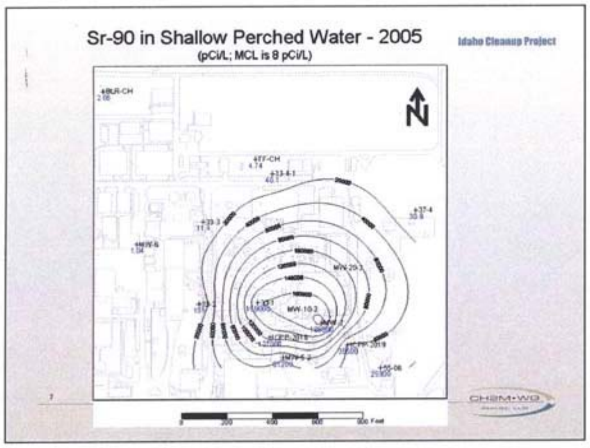
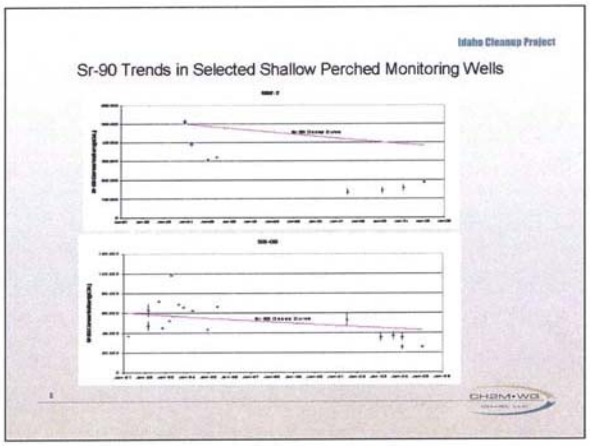
Appendix A





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Perched Water Remedial Activities Completed

- Old percolation ponds taken out of service 8/26/02
- Sewage effluent re-directed to new percolation ponds 12/02/04
- Concrete-lined ditches installed around Tank Farm (2003-04)
- Lined evaporation pond installed in 2003
- Subsurface injection of steam condensate has been reduced
- Lawn irrigation reduced
- Several underground water line leaks located/repaired 2004-05
- Performed INTEC water balance (2005)
- Monthly perched water-level monitoring
- Annual perched water sampling

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Precipitation Infiltration – Diffuse Recharge

Runoff to Unlined Ditch
(5/12/05)

Ponded Rain TF Wellset
(5/12/05)

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Precipitation Infiltration – Focused Recharge

Unlined Ditch South Side CPP-691
(5/12/05)

CPP-748 Lift Station with Dry Well
(5/12/05)

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Reasons for enhanced infiltration of precipitation:

- Lack of vegetation inside the fence (no transpiration)
- Gravelly alluvium at surface (no soil horizon)
- Large areas with pavement or buildings shed water to perimeter
- Closed depressions and unlined ditches cause ponding of water
- Snowplow accumulation areas concentrate melt water

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Precipitation Infiltration Information:

- Area of northern INTEC: ~ 95 acres (north of CPP-666)
- Average precipitation: 8.5 in/yr
- Volumetric precip. for northern INTEC: ~22M gal/yr
- Precip. infiltration volume for northern INTEC: ~18M gal/yr (assumed that 85% of total precipitation infiltrates)
- Precip. infiltration replaces the volume of the shallow perched water (~10 M gal) twice per year
- Because it is further away, channel seepage beneath the Big Lost River is less important than precipitation infiltration with respect to Sr-90 transport in the upper shallow perched water

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Actions Completed to Reduce Precipitation Infiltration

- Tank Farm Interim Action (TFIA) project installed around the Tank Farm to reduce water infiltration (2003-04), including:
  - installation of concrete lined ditches
  - storm water lift station at Beech St and Olive Ave
  - lined evaporation pond constructed outside east fence

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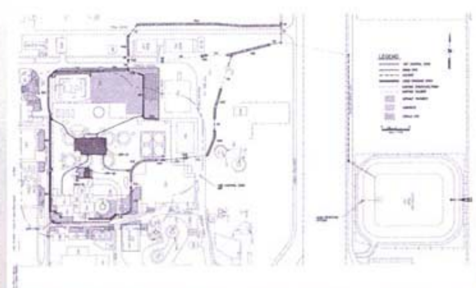
Tank Farm Interim Action Drainage System



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Tank Farm Interim Action Drainage System
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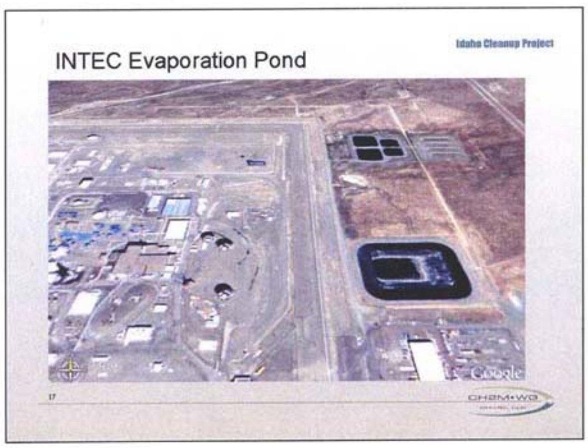
Idaho Cleanup Project
INTEC Evaporation Pond
Google
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Precipitation Infiltration – Roof Runoff
West Side CPP-666 (5/12/05)
South Side CPP-699 (5/12/05)
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Precipitation Infiltration – Roof Runoff

8.5 in/yr precipitation = 230,000 gal/acre/yr

Building	Roof Area	Annual Runoff
CPP-601	0.56 ac	130,000 gal
CPP-659	1.0	230,000 gal
CPP-663	0.78 ac	180,000 gal
Total	**2.34 ac**	**540,000 gal**

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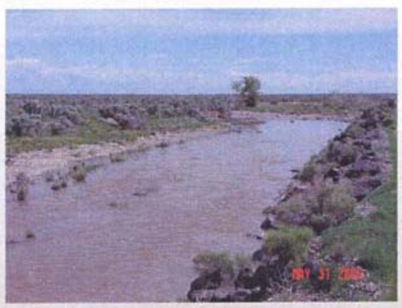
Big Lost River Channel Infiltration



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Effect of BLR on Perched Water

- Modeling performed after relocation of percolation ponds indicated BLR channel seepage was largest remaining contributor to perched water recharge
- Evaluation of 2005 BLR flow event suggests that channel seepage does not impact the upper shallow perched water beneath the tank farm, but does recharge the deep perched water
- BLR infiltration is now believed less important for shallow perched Sr-90 transport than previously believed
- Extended BLR flow anticipated summer 2006 will be monitored to confirm effects on perched water

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Anthropogenic Water

- Intentional Discharges
  - lawn watering
  - fire hydrant testing
  - cooling water discharges
  - septic system leachfields
- Unintentional Discharges
  - pipeline leaks

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Cooling Water Discharge to Unlined North Ditch

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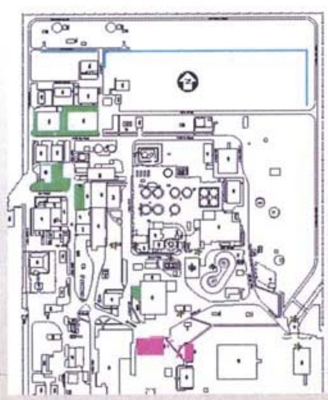

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Anthropogenic Water Infiltration: Pipeline Leaks

- Goal: Minimize leakage of clean water from pipelines within northern INTEC
- Ways to Identify and Locate Pipeline Leaks
  - Geyser or ponding at surface
  - Flow changes (water metering data)
  - Perched water level changes
  - Anomalous perched water temperatures

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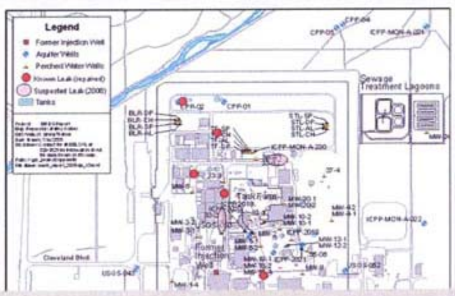
Anthropogenic Water Infiltration: Pipeline Leaks



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Some Known Water Leaks (2004-05)

- CPP-612: 1M+ gal (?) fire water leak identified 8/04/04
- CPP-654: ~5M gal/yr fire water leak identified 2/2/06
- CPP-748: ~100,000 gal raw water leak on 1/31/04
- CPP-1608: 10,000+ gal (?) steam leak; discovered 10/23/04
- CPP-1610 water softener brine leak noticed 2/25/05
- CPP-1663: 8,000 (?) potable leak on 7/21/05
- CPP-1663: ?? gal raw water leak; summer 2004
- CPP-1673: 1M gal potable water leak; 3/29/05 to 4/09/05
- Hydrant HYD-3507: ~ 38,000 gal fire water leak on 6/15/04
- Hydrant HYD-6511: ~ 5,000 gal fire water leak on 6/28/05
- Hydrant HYD-1505: ~3M gal fire water leak; 2004-05

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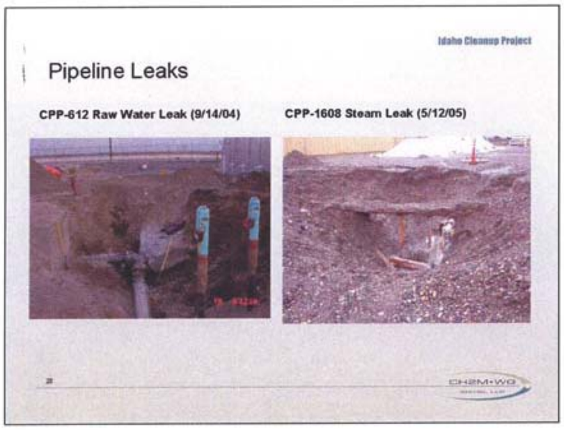
Idaho Cleanup Project
Pipeline Leaks
CPP-612 Raw Water Leak (9/14/04)
CPP-1608 Steam Leak (5/12/05)
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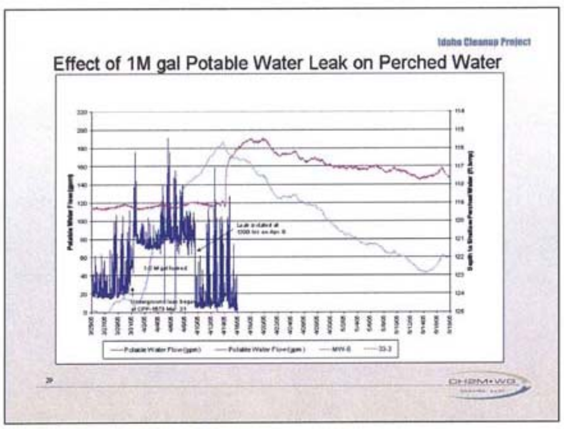
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Effect of 1M gal Potable Water Leak on Perched Water
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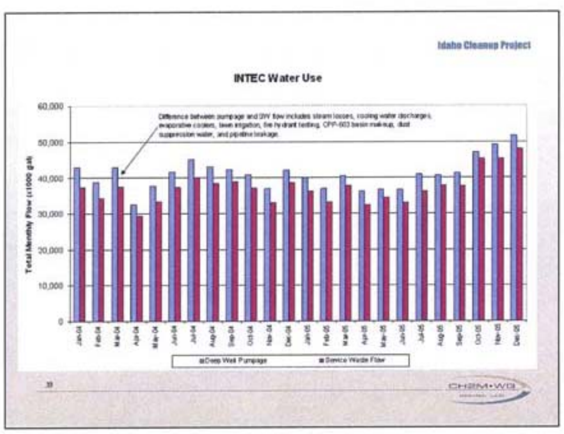
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INTEC Water Use
Total Monthly Flow (x1000 gal)
60,000
50,000
40,000
30,000
20,000
10,000
0
Deep Well Pumpage
Service Waste Flow
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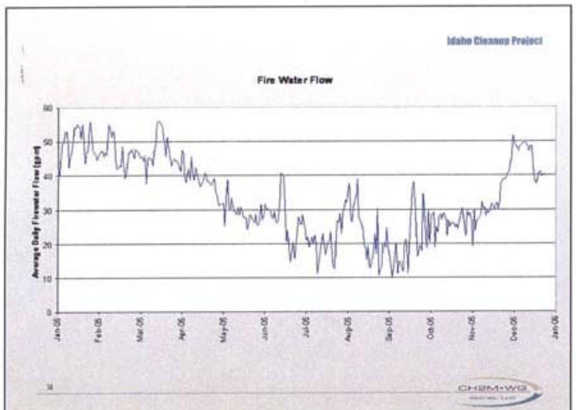
Appendix A



Infiltration Control Zones

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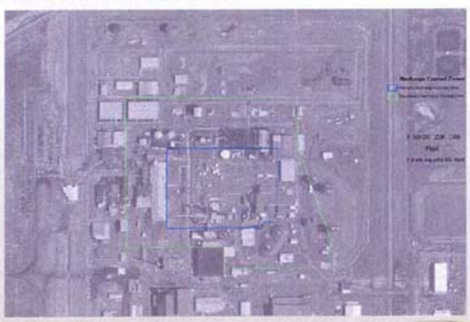

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Water Volumes (northern INTEC only)

Water Source	Water Volume
Total Precipitation	~ 22M gal/yr
Precipitation Infiltration	~ 18M gal/yr
Known Pipeline Leaks	5+ M gal/yr
Lawn Irrigation	~ 3.4M gal/yr
Roof Runoff (SRCZ)	~ 2M gal/yr
Cooling Water to Ditch	~ 0.4M gal/yr
Septic Leachfields	~ 0.2M gal/yr
Fire Hydrant Testing	~ 0.1M gal/yr

Total INTEC Pumpage ~ 498M gal/yr (2005)
Unaccounted Water ~ 44M gal/yr (9% of pumpage)

Shallow Perched Water ~ 10M gal

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